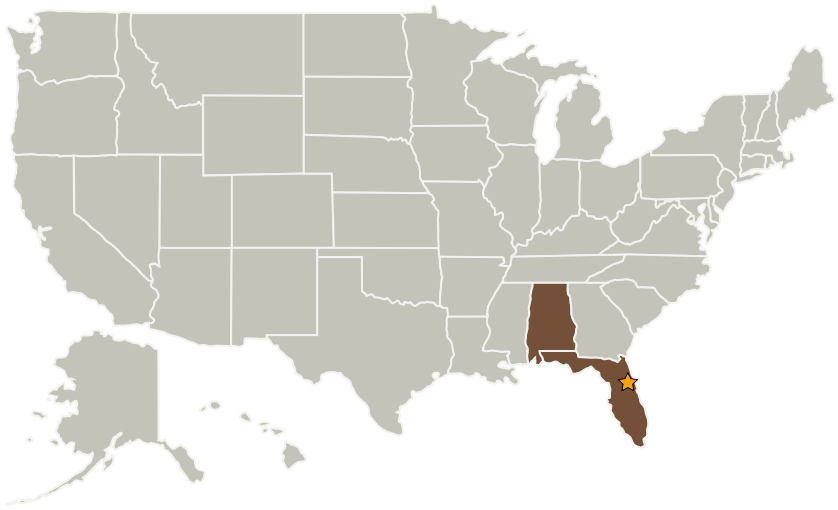
Numerical Simulation of Rocket Exhaust Interaction with Lunar Soil, Phase II

Completed Technology Project (2008 - 2010)

Project Introduction

Rocket plume impingement can cause significant damage and contaminate co-landing spacecraft and surrounding habitat structures during lunar landing operations. CFDRC and the University of Florida will develop an innovative simulation system for predicting surface erosion and debris transport caused by lunar surface rocket plume impingement. This simulation system combines 1) a unified continuum-rarefied flow solver capable of simulating plume impingement flow in lunar vacuum, 2) granular solid-fluid interaction simulation models for developing databases for lunar soil erosion and debris particle release mechanism, and 3) particle tracking tools to simulate debris kinetics and dispersion after liberation. During Phase I, the Unified Flow Solver (UFS) capabilities in simulating hybrid rarefied-continuum plume flow, and the debris dispersion tracking capabilities were demonstrated. The fluid-solid simulation tools realistically simulated jet induced soil grain response characteristics, clearing the path towards establishing working models of erosion and particle release mechanisms. In Phase II, the individual modules will be refined, validated and integrated into a coherent simulation system. The solid-fluid interaction physics will be refined for the peculiar lunar soil layer characteristics and consequently soil erosion models will be derived. The erosion models will serve to prescribe debris initial conditions for a debris-tracking module developed and integrated with the flow solver. The simulation capability will be essential for predicting the severity and range of dust and debris transport and for designing lunar settlement layout, dust and debris impact mitigation measures.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
CFD Research Corporation	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Florida

Project Transitions

September 2008: Project Start

September 2010: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX09 Entry, Descent, and Landing
  - TX09.4 Vehicle Systems
    - TX09.4.5 Modeling and Simulation for EDL